Prepared and Published with the Support of the
DAKOTA COUNTY SOIL AND WATER CONSERVATION DISTRICT AND BOARD OF COMMISSIONERS
AND MINNESOTA DEPARTMENT OF NATURAL RESOURCES, WATERS DIVISION

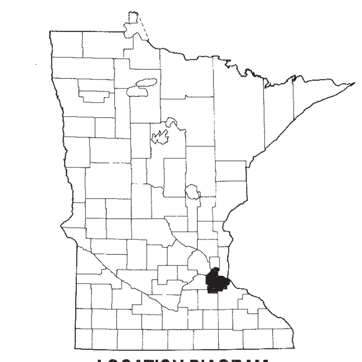
DATA BASE MAP

By

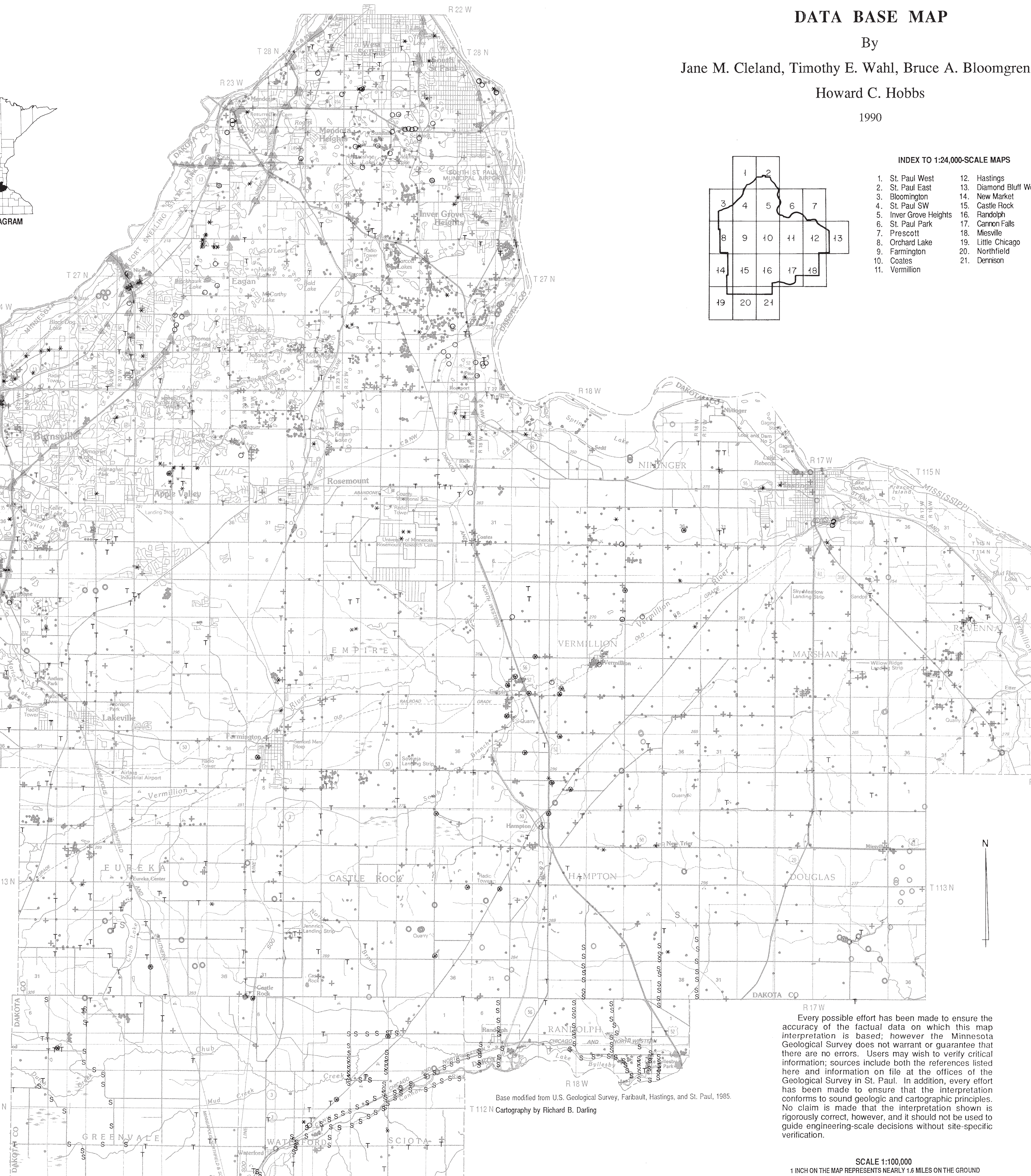
Jane M. Cleland, Timothy E. Wahl, Bruce A. Bloomgren, and

Howard C. Hobbs

1990



LOCATION DIAGRAM



Base modified from U.S. Geological Survey, Faribault, Hastings, and St. Paul, 1985.

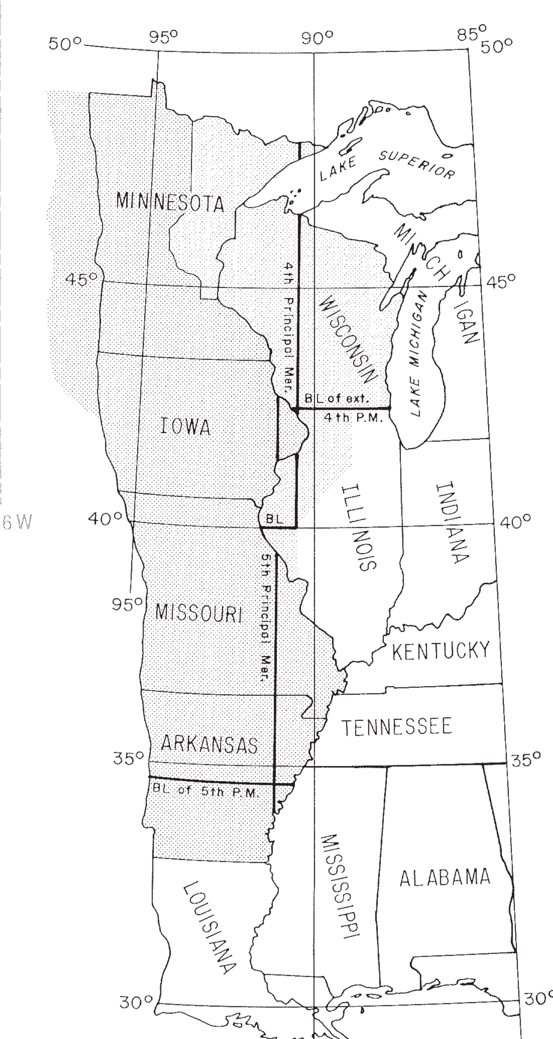
Cartography by Richard B. Darling

INDEX TO 1:24,000-SCALE MAPS

1. St. Paul West
2. St. Paul East
3. Bloomington
4. St. Paul SW
5. Inver Grove Heights
6. St. Paul Park
7. Prescott
8. Orchard Lake
9. Farmington
10. Coates
11. Vermillion
12. Hastings
13. Diamond Bluff West
14. New Market
15. Castle Rock
16. Randolph
17. Cannon Falls
18. Miesville
19. Little Chicago
20. Northfield
21. Dennison

EXPLANATION

- Record of water-well construction
- Cutting samples of glacial drift and bedrock
- Borehole geophysical log (combined with other symbols)
- Soil boring record
- Bedrock exposure
- T Textural analysis of glacial drift
- S Seismic study
- + Water-quality data
- Sinkhole
- Spring
- S Seep



Several townships in Dakota County were surveyed from the 4th principal meridian and base line established in 1831 for Wisconsin. Most of the county—and most of Minnesota—were surveyed later from the 5th principal meridian and base line in Arkansas that was established in 1815. Because the two surveys had considerably different starting points, township numbers are very different in the northern and southern parts of the county. Map modified from Thompson, M.M., 1979, Maps for America: U.S. Geological Survey.

SCALE 1:100,000
1 INCH ON THE MAP REPRESENTS NEARLY 1.6 MILES ON THE GROUND

KILOMETERS 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
MILES 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13

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COUNTY WELL INDEX - MINNESOTA GEOLOGICAL SURVEY.

************************************************************************
MN. UN.NO. : 127263
LOCAL ID.NO:                 NAME : APPLE VALLEY 6                    CWI

      PERMIT NO:                 USE   : MUNICIPAL      DRILLED: 76/08/27
      COUNTY    : DAKOTA         DEPTH:  507 FT.        DIAM.   : 16 IN.
      T/R/SEC. : 115/20/26BBCB   CASED:  426 FT.        CASING : STEEL
      ELEVATION:  990 FT.        GROUT:  426 YDS.       DRLR/DS:
      DPTH BDRK:    49 FT.       BEDRK:PLATTEVILLE
      OPEN HOLE: PRAIRIE DU CHIEN GROUP-JORDAN
      AQUIFER   : PRAIRIE DU CHIEN GROUP-JORDAN
      QUAD      : FARMINGTON
      POTENTIAL POLLUTION SOURCE :  400 FT.

      DATE   NITRATE  BACTERIA  SOURCE  SWL   ELEV  SOURCE
      ----   -------  --------  ------- ----  ----  -------
      78/02   <0.4               MDH    129   861    62012

      COMMENTS: 700 FT. S. OF 140TH ST. & CO. RD. 40
                CASING: 30 TO 50; 16 TO 426.
                M.G.S. NO.1144
                MGS WATER WELL DATA BASE LOG IS AVAILABLE.
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MINNESOTA GEOLOGICAL SURVEY
DAKOTA COUNTY WELLOG DATA BASE.                                   WELLOG

UNIQUE NO.: 127263
WELL NAME : APPLE VALLEY 6

COUNTY     : DAKOTA                  DATE ENTERED:  89/07/12.
ADDRESS    :                                APPLE VALLEY
QUADRANGLE: FARMINGTON 7.5 MINUTE
TOWNSHIP   : 115 NORTH               UTM-EASTING : 484415
RANGE      :  20 WEST                UTM-NORTHING: 4954384
SECTION    :  26/BBCBBB              UTM-ZONE     : 15
LATITUDE   : 44:44:40 N              LONGITUDE    : 93:11:48 W
LOCATED BY: INFO. FROM OWNER

ELEVATION :  990 FT.                 WATER LEVEL : 129 FT.  (EL. 861 FT.)
DEPTH      :  507 FT.                DATE         : 76/07/07
COMPLETED : 76/08/27                 AQUIFER(S)   : PRAIRIE DU CHIEN GROUP-
                                                  : JORDAN

DNR PA NO.: 74-5229

WELL USE   : MUNICIPAL
DRILLER    : (AND/OR DATA SOURCE) KEYS WELL CO.
  LIC. NO.:  62012
CASING     : STEP DOWN
           :  30 INCH TO   50 FEET
           :  16 INCH TO  426 FE

SOURCE OF POSSIBLE CONTAMINATION
  FEET:   400   DIRECTION: NORTH   TYPE: CITY GARAGE

SCREEN
 MAKE/TYPE: NONE

PUMP       : DATA UNAVAILABLE

REMARKS    : M.G.S. NO. 1144
------------------------------------------------------------------------
                              PUMPAGE TEST
------------------------------------------------------------------------
DATE: 76/07      TEST 1  TEST 2  TEST 3  TEST 4  TEST 5  TEST 6
------------------------------------------------------------------------
HOURS               17      10
RATE(GPM)         2010    1230
DRAWDOWN(FT)        99      66
------------------------------------------------------------------------
                              GEOLOGIC LOG
------------------------------------------------------------------------
DEPTH
INTERVAL                  STRATIGRAPHIC UNIT
(IN FEET) LITHOLOGY       SYSTEM/GROUP/FORMATION   AGE HARDNESS COLOR    DRILLER'S DESCRIPTION
------------------------------------------------------------------------  ---------------------

  0    49 DRIFT           QUATERNARY UNDIFF.       QUA                   DRIFT
 49    67 LIMESTONE       PLATTEVILLE              ORD                   PLATTEVILLE
 67    75 SHALE           GLENWOOD                 ORD                   SHALE
 75   220 SANDSTONE       ST.PETER                 ORD                   ST. PETER SANDROCK
220   417 DOLOMITE        PRAIRIE DU CHIEN GROUP   ORD                   SHAKOPEE
417   441 SANDSTONE       JORDAN                   CAM                   SHAKOPEE
441   507 SANDSTONE       JORDAN                   CAM                   JORDAN
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MINNESOTA GEOLOGICAL SURVEY
DAKOTA COUNTY TESTHOLE DATA BASE.                                 TESTHOLE

   UNIQUE NO.   :   1504                    UTM EASTING    :  486561
   COUNTY       : DAKOTA                    UTM NORTHING   : 4967294
   DATA SOURCE : MINNESOTA HIGHWAY DEPARTMENT UTM ZONE      : 15
   PROJECT NO.  :  1986-02                  LATITUDE       : 44:51:39 N
   BRIDGE NO.   :                           LONGITUDE      : 93:10:12 W

   DATE BORED   : 70/05/21                  WATER LEVEL    :  40 FT.
   ELEVATION    :  828 FT.                  DRY HOLE       :  NO
   DEPTH        :  41.0 FT.                 HAMMER         : 140/30/2
   SOIL CLASS.  : MINNESOTA HIGHWAY DEPT.

----------------------------------------------------------------------    ------------------
DEPTH                       BORING LOG                     TESTS
INTERVAL   ------------------------------------   ------------------     DRILLER'S DESCRIPTION
(IN FEET)  LITHOLOGY          STRATIGRAPHY         MS  C  CR  MC
-----------------------------------------------   ------------------     ------------------
 0.0   9.0 SAND               PLEISTOCENE          M   D      10         SAND BROWN
 9.0  11.5 SAND               PLEISTOCENE          M   A      22         SAND BROWN
11.5  13.5 SAND               PLEISTOCENE          M   B      14         SAND BROWN
13.5  16.0 SAND               PLEISTOCENE          M   A      12         SAND BROWN
16.0  18.5 LOAMY SAND         PLEISTOCENE          M   A      22         LOAMY SAND BROWN
18.5  21.0 SAND               PLEISTOCENE          W   C      18         SAND BROWN
21.0  23.0 SAND               PLEISTOCENE          W   E      13         SAND BROWN
23.0  30.0 SAND               PLEISTOCENE          W   E      20         SAND BROWN
30.0  35.0 SILTY LOAM         PLEISTOCENE          M   E      22         SILTY LOAM GRAY
35.0  41.0 SILTY LOAM         PLEISTOCENE          W   E      17         SILTY LOAM BROWN

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ABBREVIATED COLUMN HEADINGS (TESTS)    COLUMN VALUES

      MS=MOISTURE                      D=DRY, M=MOIST, W=WET
      C =CONE TEST                     A=0-4,B=5-9,C=10-15,D=16-30,E>30;IN BLOWS/FT.
      CR=CORE RECOVERED                PER CENT RECOVERED X10
      MC=MOISTURE CONTENT              PER CENT

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INTRODUCTION

The public health and economic development of Dakota County are directly dependent upon the wise use and management of its land and water resources. Geologic and hydrologic information is essential before decisions are made that affect natural resources. Although the amount of geologic information required for making specific decisions can vary, the information will not be used at all if it is not available when it is needed, or if it is available only in a highly technical form or scattered in many different maps and reports.

The Minnesota Geological Survey county atlases present detailed geologic and hydrologic information in an interpretive as well as descriptive form. Maps and texts either summarize basic geologic and hydrologic conditions at a county scale or interpret these conditions in terms of the impacts of possible land-use and water-use decisions. Site-specific information also is available at a greater level of technical detail than shown on the maps of this atlas. These data are too voluminous to present in the atlas, but have been incorporated into readily accessible files housed at the Minnesota Geological Survey.

Several sources commonly provide information about an area or an individual property, but they may use different classification schemes to describe the same geologic materials. As a result, discrepancies in interpreting the data may arise or the different sources may appear to contradict each other. For example, water-well contractors may describe glacial till as "clay," but engineering records will describe it as a "clayey sand." Both descriptions are acceptable for their original purposes. "Clay" defines the general inability of the till to yield ground water to a well. "Clayey sand" defines the physical composition of the till relative to particle size and engineering properties. A geologic interpretation of both descriptions defines the material in terms of how it formed rather than in terms of how it is to be used. In this example, "till" is the unsorted jumble of rock fragments ranging in size from clay to cobbles and boulders that was deposited directly by glacial ice.

All of the types of data described on this plate had to be interpreted by geologists or hydrogeologists before they were meaningful for mapping purposes. The 1:100,000 scale and smaller scales of the maps in this atlas were chosen because they can show the geologic and topical studies of the county while keeping the physical size of each plate to a manageable level. As a result, some detailed information that was gained by data interpretation and mapping cannot be shown on these maps or discussed in the texts.

Whether to use the atlas alone, or to use the data bases, depends on the amount of detail needed. Generally, information in the data bases must be used to evaluate site-specific conditions, and test drilling may be necessary.

THE DATA BASE MAP

The types and locations of information used to prepare this atlas are shown on the map above. The map is current as of November 1989. The data are described below to aid the user in assessing which types of information may be useful for a particular need. The map shows where data are sparse or lacking, and interpretation and extrapolation were required to prepare a map. Therefore, the data base map is a guide to the precision of the other maps in the atlas.

Drill-Hole Information

A **record of water-well construction,** or well driller's log, is a water-well contractor's description of the geologic formations penetrated during drilling and the construction materials used to complete the well. Hydrologic data, such as the static water level and test-pumping results, are commonly included. Before any driller's log can be used, the location of the well must be verified, and a geologist must interpret the log. Drillers' logs are the primary source of subsurface geologic and hydrologic data for Dakota County, and about 3200 of the estimated 3500 logs available were used for this atlas. On the map, water-quality points also represent well locations.

Cutting samples are collected at set intervals (usually every 5 feet) during drilling from wells selected by the Minnesota Geological Survey on the basis of the need for additional data. They can be washed and studied under a microscope to determine rock type, grain size, color, and impurities. They provide physical evidence of subsurface geologic materials and are the principal means of establishing the nature of the glacial materials and bedrock.

Borehole geophysical logging measures differences in the electrical and natural radioactive properties of subsurface materials. The gamma log in the column on Plate 2 is an example. It was obtained by lowering an instrument into an existing well to measure the low-level radiation given off by the rock. The signal was transmitted to a receiver which printed the log on graph paper. Peaks on the log reflect layers rich in potassium, which is found in some clays and feldspars. The graphic logs are correlated with cutting samples from the same hole or with information obtained from nearby outcrops or another nearby geophysical log. Each bedrock formation has a characteristic graphic configuration, and therefore these logs permit the acquisition of high-quality subsurface geologic and hydrologic information from wells for which little or no other information is available.

Soil borings are test holes drilled to obtain information about the physical properties of subsurface materials for engineering, mapping, or exploration purposes. Most terminate at very shallow depths or where bedrock is encountered. They are logged by an engineer or a geologist using a variety of classification schemes based upon particle sizes, penetration rate, moisture content, and color. Soil borings data are most useful in determining the composition of unconsolidated deposits. Some logs include the depth to bedrock and the lithology of the first bedrock encountered.

Other Information

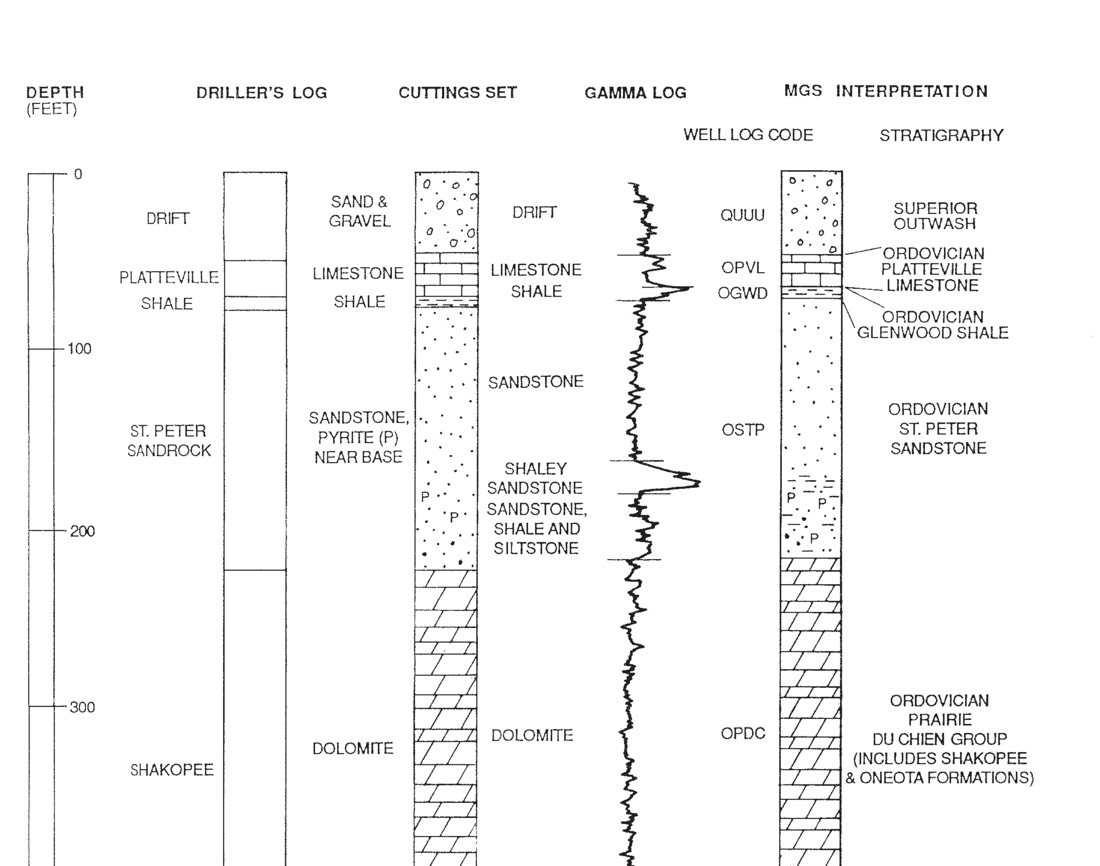
Bedrock outcrops are exposures of solid rock at the land surface. The inventory of outcrops includes about 95 percent of the total exposed bedrock. The remainder are mostly small exposures created during construction. Some exposures of bedrock that are described in historical records are no longer visible. Although in much of Dakota County they are limited in distribution, they serve as reference points for mapping and for checking the accuracy of subsurface data. Bedrock at or near the surface must be considered in some land-use planning decisions, such as pipeline routing, sewage-system design, and excavations.

Textural analyses express the proportion of sand-, silt-, and clay-size particles that make up a sample. They are helpful in identifying and mapping unconsolidated materials, such as glacial deposits. The samples analyzed were taken from selected areas where other data were sparse or lacking.

Seismic soundings are a geophysical method that measures the time required for sound or pressure waves to travel from a source to a receiver. The density and rigidity of the material through which the waves must travel affects their travel time. Bedrock such as limestone or dolomite exhibits seismic velocities 3 to 4 times those of unconsolidated deposits because bedrock is much more dense. The spacing of the receivers (geophones) and the arrival times (measured in milliseconds) are used to calculate the depth to bedrock. Seismic soundings are labor intensive but can provide high-quality data when no other sources of subsurface information are available.

Water-quality data are obtained from records at the Dakota County Public Health Department and the Minnesota Department of Health. These data are incorporated in WELLOG in order to pair water-quality values with information on aquifers and well construction. Only water-quality data matched with a well log were plotted on the map.

Sinkholes, springs, and seeps were located by sighting and also by talking with local residents. Sinkholes occur where the surface is underlain by carbonate bedrock that can be dissolved by mildly acidic ground water to form circular to elliptical depressions. These depressions range in size from less than 3 feet to more than 50 feet in diameter and from 1 to about 50 feet in depth. Springs are ground water issuing onto the surface. Seeps are places where the surface is saturated with ground water.



MGS interpretation of data from three different sources

Comparison of geologic data obtained from a driller's well log, a cuttings set, and a gamma log. Information from all three sources generally agrees, but a geologist can learn something different from each source. The well log gives a list of rock units as described by the driller, recorded as the well was drilled. A cuttings set is a group of samples obtained from the well as it is being drilled. Cuttings provide much information, but drilling action can obscure clays and shales and mix samples. Gamma logs are obtained by measuring low-level radiation in rock units; the signal is printed on graph paper. From a gamma log, a geologist can pick contacts between formations and also describe the hydrologic features of the units. The log indicates that the basal St. Peter Sandstone contains approximately 20 - 25 feet of shale, which acts as a confining layer above the underlying Prairie du Chien - Jordan aquifer. A hard zone in the Jordan is probably due to feldspathic cement which results in a peak on the gamma log. Whenever possible, a geologist uses all three sources to make conclusions about various formations.

DATA BASE MANAGEMENT

All of the data shown on the map were plotted on 7.5-minute topographic quadrangle maps, half-section maps, or highway alignment maps, and inventory numbers were assigned to all except bedrock exposures and some soil borings. Manual files and automated data bases were developed to provide easy access and rapid retrieval of these site-specific data. The data may be obtained from the Minnesota Geological Survey.

Computer storage and retrieval systems are better than manual files for manipulating large amounts of data. Automated geologic data bases may be designed to interact with other computer files, such as land-use data. Such interaction permits more efficient assessment of cause-and-effect relationships concerning natural resources than is commonly possible with manual files.

Several computer files were developed for point-source data in Dakota County. All of them use Public Land Survey coordinates as location criteria, and thus they are compatible with the natural-resource data bases housed at the Minnesota Land Management Information System. The automated data bases for Dakota County are: (1) water-well logs or WELLOG, (2) a county well index of aquifer usage and ground-water quality data or CWI, (3) soil borings and engineering test holes or TESTHOLE, and (4) sinkholes, springs, and seeps data.

Information from water-well logs is entered into the Minnesota Geological Survey's WELLOG data base, which is a statewide file. Each log is assigned a six-digit unique number that also is used by state agencies and the Water Resources Division of the U.S. Geological Survey. Well locations are described in terms of Public Land Survey coordinates and also are digitized from 7.5-minute topographic maps and half-section maps to obtain Universal Transverse Mercator and latitude-longitude coordinates. Elevations, expressed in feet above sea level, are determined from these topographic maps (see the index to 1:24,000-scale maps for quadrangle names). Software at the Minnesota Geological Survey is used to display and tabulate many of the data elements contained on the original well log. An example of WELLOG output is shown to describe these elements.

Well-repair and abandonment records are not directly applicable for entry into WELLOG, but they contain useful information on ground water. In addition, community testing programs and the Minnesota Department of Health collect data on ground-water quality (mostly nitrate and coliform bacteria counts) and include some depth and construction data from wells that are sampled. These data, along with any historic static water-level measurements, are stored by unique number in the CWI (county well index) data base. CWI combines the water-quality data with location and selected depth data from WELLOG to form a catalog of aquifer use within the county. The street address of each well is also included whenever possible in order to provide data users with a well-location system that is compatible with local regulatory programs. A comparison of the example of CWI output with the WELLOG output shows specific differences between the two files.

Information from soil borings and engineering test holes is stored in an automated file called TESTHOLE. Descriptions of the rock types penetrated and the soils classification system used are entered, together with specific field and laboratory tests. The most common tests are blow counts, liquid and plastic limits, water content, and dry density. The depth to the water table is entered if available. Each test hole receives a unique number, and the location is digitized from the site plan. An example of TESTHOLE output is shown to illustrate these elements.

Sinkholes, springs, and seeps in Dakota County are assigned a five-digit code and their UTM coordinates entered into the Minnesota Geological Survey data base. Additional information, such as type of feature, formation in which it occurs, elevation, and land owner, if any, is available in manual files.

FUTURE DATA COLLECTION

The map on this plate was current as of November 1989. A data base map is out of date even before it is printed, because additional information is continually generated as new water wells are drilled, construction activities expose more bedrock, or another well is tested for water quality. The library of geologic information prepared for Dakota County is flexible so that old data can be reevaluated in light of new information, and new forms of data can be added if required. The need to manage ground water and other natural resources wisely will never become outdated. Future demands on these resources will require current data to assess the impacts.

ACKNOWLEDGMENTS

Staff members of the Minnesota Geological Survey who contributed to the development of the data bases include: Cynan Benedikt, Christopher Bratsch, Jacqueline Duley, Philip Heywood, Dirk Korth, Richard Marsh, Peter Moody, and Joyce Meints. We thank local water-well contractors and landowners for their valuable assistance.